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# SCIENCE



*In This Issue*

## Influences on Dental Defects in Naval Personnel

C. A. Schlack and J. E. Birren



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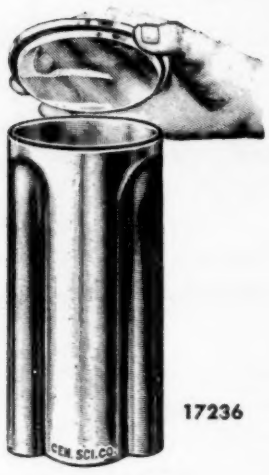
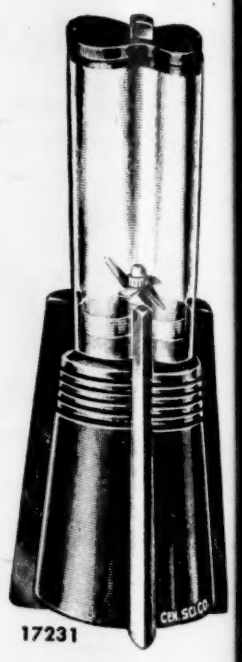
# The WARING BLENDOR



17236

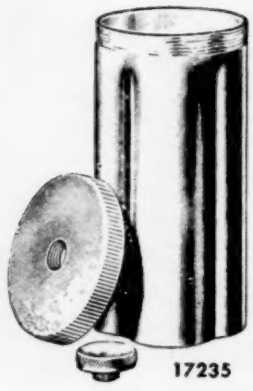
Dozens of vital, new uses make it a necessity in every laboratory. Blends, Comminutes, Pulps, Macerates and Mixes Materials.



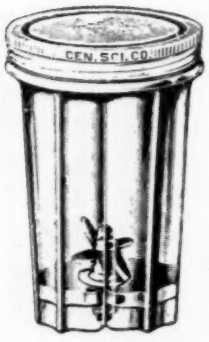
17231

**No. 17231—Waring Blendor** with Standard Glass Jar. **Each** $33.35

**17236—Aluminum Container,** Plain Cap, same as 17235, but without screw threads and provided with loose-fitting, transparent, plastic cap. **Each** $11.00

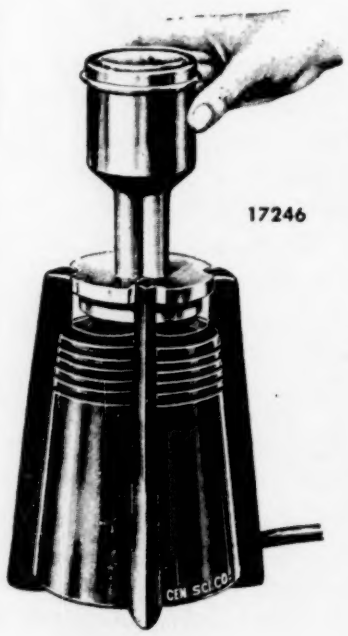

17235

**17235—Aluminum Container,** Full capacity 1000 ml, Screw Cap for use on Waring Blendors for preparation of sterile biological products. Made of aluminum alloy with alumilite finish. Fitted with air-tight, screw-cap cover with threaded sampling plug in center. With blending assembly. **Each** $15.10

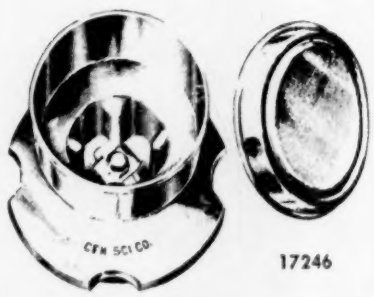


17244

**17246—Monel Metal Container,** Semi-Micro, with friction-fit monel cover and small size blending assembly. **Each** $19.55



17246



17246

Top view of No. 17246 Monel Semi-Micro Container showing blades of blending assembly and constricted neck and small volume of lower portion of container.

**17244—Glass Container,** Small Size, Full Capacity 500 ml; minimum, 30 ml. Made with metal screw cap and small size blending assembly for use on Waring Blendors. **Each** $7.15

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SCIENCE

Vol. 104, No. 2699 Friday, 20 September 1946

# Influences on Dental Defects in Naval Personnel

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RECRUITING AND INDUCTION of large numbers of men into the military services has resulted in the accumulation of considerable information on the educational and medical status of the American people. Frequently, personnel drawn from the various regions of the country display marked differences. It is the purpose of this paper to present certain important regional differences in the dental status of men entering the Navy and to relate these differences to some simple sociological data.

To estimate the number of dentists required to treat a Navy of any given size, it is necessary to know the number of dental defects in various age groups as well as the rate of increase of dental defects with increasing age. Attention will be directed here only to the determination of the number of dental defects in naval personnel at the time of entry into the service. Interest in this topic came about as a result of the desire of the Dental Division (Bureau of Medicine and Surgery) to evaluate the dental needs of the service. Several excellent studies have been made in the past on the dental status of a given population of adults, but they have usually been limited to a study of only a small section of the country or a small number of cases (*1–4*). For the study conducted by the Dental Division a wealth of material was available.

Duplicate dental records of 69,584 men who were coming on active duty in the Navy in 1941–42 were coded and transferred to punch cards through the cooperative efforts of the Research Division, Bureau of Medicine and Surgery, Naval Dental School, and the Vital Statistics Division of the Bureau of Medicine and Surgery. These data were then sorted by the latter Division into the distribution of dental defects (a) in the entire sample, (b) by region of birth, and (c) by age groups.

[1] The material in this article should be construed only as the personal opinions of the writers and not as representing the opinion of the Navy Department officially.

## Sample of Personnel

The men comprising this sample were principally white enlisted volunteers, although a few men on fleet reserve status who were called to active duty were also included. Upon entering "boot camp" for training they were given a dental examination which supplied the data for this paper. Before reaching "boot camp," however, some men were eliminated at local recruiting boards for dental defects. At the time the present sample of men entered the service about 7 per cent had been eliminated for dental reasons in accordance with the dental standards of the service at that time. These applied to all regions, although it is probable that more men were screened out in some regions than in others. The effect of this screening is to decrease regional differences slightly, so it may be that, in the population at large, greater regional differences may exist than those noted here.

The dental standards at the time the men were examined required a total of 18 serviceable teeth. These teeth were to include two opposing molars on either side, four serviceable incisors, and good occlusion. The man had to be free from oral infections and to have suitable prosthetic replacements for any wide edentulous areas. Teeth with large cavities impossible to repair were not considered serviceable teeth (*7*).

The mean age of this group of men was 24 years, and about 82 per cent of the men were below 30 years of age; these data are very close to the age distribution of all enlisted men in the service at that time (*9*).

All the data on these men were divided into geographic regions according to place of birth. The states comprising each region of the country are shown in Fig. 1. The smallest number of men from any one region came from the mountain states. However, even this region contributed a sizable group of men—3,672, or slightly over 5 per cent of the total number of men in the sample who were born in this country (*8*). The basis for dividing the states into regions was one of

convention and followed that of previous papers on national dental problems (*6*). The slight differences in distributions of ages for the various regions were corrected, but this was almost without effect on the final picture of regional differences, because the groups of men from the various regions had almost the same age distribution.

## "The Average Man"

The mean number of simple and compound cavities was found to be about 10 per person, which is in striking contrast to the 5 fillings found per person (*10*).

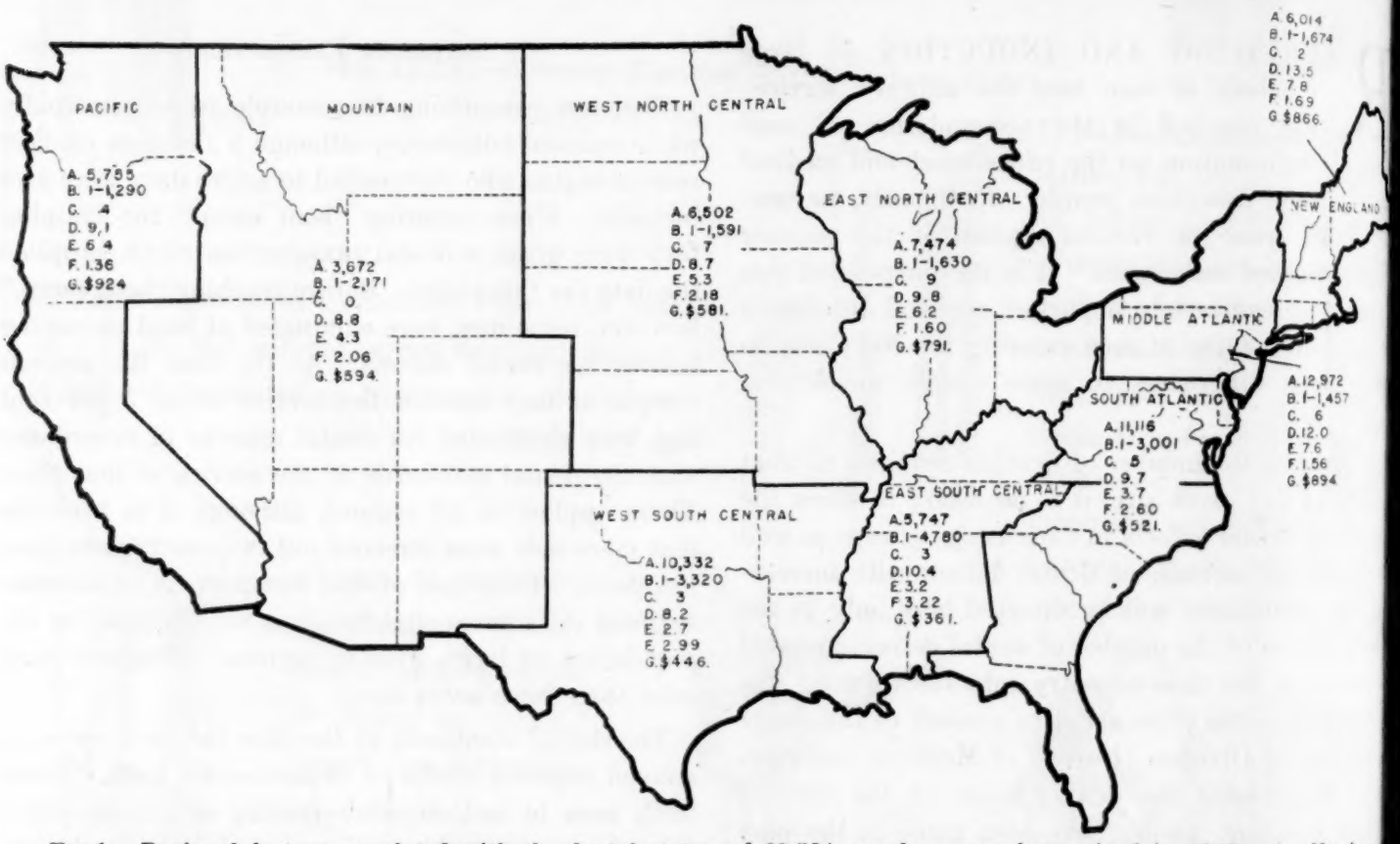


FIG. 1. Regional factors correlated with the dental status of 69,584 naval personnel examined in 1942. A—Number of cases; B—Dental ratio (dentist to population); C—Number of dental schools; D—Cavities (simple and compound); E—Restorations (fillings); F—Index of dental attention; G—Mean income.

This means, in effect, that the "average man" required more dental attention upon entering the service than he had received up to that time. A similar finding has already been reported by the Public Health Service for children (*5*). It thus appears that, in any large portion of the population of this country, the amount of dental attention required is far in excess of that already rendered. The ratio of dental treatment required to dental treatment already rendered can be used as an index of dental attention, which, as will be shown later, varies considerably throughout the country (*10*).

It has been estimated that it would require .00406 dentist years per person to treat the defects found in the present study—a figure arrived at by dividing the total work done by naval dentists during a given period by the number of dentists on duty (*10*). In a similar manner the amount of time already expended per person could be estimated. The time received by the "average" person in treatment prior to entering the Navy was estimated at .00211 dentist years. The ratio of .00406 dentist years required to .00211 dentist years rendered indicates that almost twice as much time was required to treat the men at the time they entered the service as they had received in the entire period preceding the examination. It should be mentioned here that the estimated dentist years of work is based on a complete year, including holidays, leave, administrative duties, and other nonclinical functions, and thus represents the total work placed in a year, not the length of time it takes to perform a specific task (*10*).

Emphasis has been placed so far on the number of cavities and fillings per person, because these represent the greatest source of dental treatment in the age group studies; with increasing age more dentures would be required. Somewhat surprising is the fact that few teeth required extraction despite the large number of carious teeth, the mean number per person being about 0.2. In contrast, the mean number of missing teeth was 4.7 at the time of examination.

## Regional Differences

There were marked differences in the number of cavities per person when the personnel were grouped according to region of birth (*10*). For example, New England had a mean of 13.5 simple and compound

avities per person, whereas the West South Central egion had only 8.2 per person. Regional differences ere found for other dental defects, and in general ew England and the Middle Atlantic had the greatest umber of defects per person, the East South Central nd West South Central regions having the least umber. The mean number of dental defects in men rom each region can be seen in Fig. 1. Differences lso appear in the number of fillings or restorations lready placed. In fact, the regional differences are reater for fillings already placed than for the number f cavities present at the time of examination. Thus, ew England, which had 64 per cent more cavities per erson than the West South Central region, had 191 er cent more fillings per person. If number of cavi- es is added to the number of fillings per person to btain the mean number of carious areas, it is found at New England tends to have about twice as many arious areas per person as the West South Central egion, *i.e.* 21.3 vs. 10.9, respectively. This leads to e conclusion that New England has a much greater ndency to caries than the West South Central re- ion, but in the former region a greater percentage of arious areas are filled.

It also appears that dental attention is not simply istributed according to regional needs. When the timated time required to treat personnel from the arious regions is divided by the estimated time al- ady spent in treatment, an index of dental atten- on is defined which shows considerable variability mong the regions. Thus, the Pacific Coast region d an index of 1.36, which means that personnel om this region required 1.36 times more dental work pon entering service than they had had up to that me. Personnel from the East South Central region, n the other hand, had an index of 3.22. The various dexes are presented in Fig. 1. It is apparent that any of the regions which have the best teeth in- rently have unusually little dental attention. This rge amount of variability suggests that some rather rong sociological forces must be operating within the untry that result in a disproportionate concentration dentists in some regions.

## Sociological Factors

In the Pacific Coast region, which had the most fa- rable dental attention index, there were 1,290 per- ns per dentist in 1940; the same region had a mean r capita income of $924. The region with the poor- t dental attention index, the East South Central re- on, had 4,780 persons per dentist and a mean income $361. When the nine regions are ranked in order om high to low for mean income, dental attention dex, and number of persons per dentist, an almost perfect relation is described between these factors. One is led to conclude, therefore, that the dentists in this country are distributed according to the relative wealth of the regions, with the result that availability of dental attention is a function of regional wealth. The three regions which had a population load of more than 3,000 persons per dentist as well as the lowest mean income per capita were the adjacent southern regions of the country, the South Atlantic, East South Central, and West South Central regions.

The West South Central region appears as a paradox on first analysis. This has next to the largest number of persons per dentist and next to lowest mean income per capita, with the result that it has next to the poorest dental index. Despite this, however, personnel from this region have inherently the best teeth in the country when the total number of cavities are added to the total number of fillings already placed (Fig. 1). From this one may infer that the presence of dentists in a region has but slight effect on the dental status of persons from that region, and whatever the natural causes operating in the various regions, they seem more important than the number of practicing dentists. This is seemingly substantiated in the New England region, which has inherently the poorest teeth of all regions and almost twice as many dentists per capita as the West South Central region.

Before it is concluded that the presence of a large number of dentists in a region does not contribute to caries prevention, it should be mentioned that there appear to be so few dentists in the country that their contribution to preventive dentistry may be so small in proportion to the effect of natural factors that it tends to become obscured.

The total number of dentists in 1940 was 70,415, which yields a national ratio of 1 dentist per 1,870 persons. This is much lower than the ratio adopted by the Navy of 1 dental officer per 500 personnel. The scarcity is accentuated by the fact that it is questionable whether even the latter ratio is adequate to take care of all the dental defects in a group of that size. If we assume that 1 dentist per 500 persons is a reasonable ratio, then it is possible to estimate the number of dentists necessary in the entire country. Dividing the population of the nation by 500 yields a figure of 263,338 dentists, of which we now have 70,415, or about 27 per cent of those required. This estimate is only a very loose approximation, since the Navy deals only with an adult population and a select group. The qualifications that must be introduced by the inclusion of children and people with severe dental defects who would be rejected for military service are uncertain, and thus the estimate is most tentative.

Aside from the issue of the number of dentists needed by this country, the apportionment of existing dentists, poses an interesting problem. Two methods of apportioning dentists that immediately suggest themselves are (a) on a straight per capita basis and (b) according to the regional needs as indicated by data of this study.

To distribute the dentists on a straight per capita basis it is necessary only to divide the number of people in each region by 1,890 (the national ratio). This division yields the number of dentists that should practice in each region if they were distributed uniformly throughout the country.

To compute the distribution of dentists according to the dental needs of the various regions, the estimated mean time for treating personnel from a region (cavities + fillings) may be multiplied by the population of that region. This estimated time may be expressed as a percentage of the total estimated time to treat the nation. To arrive at the number of dentists per region, if they were distributed according to regional dental needs, this percentage is then multiplied by the number of existing dentists.

Table 1 lists the actual distribution of dentists in 1940 by regions (*6*), the distribution on a simple per capita basis, and the distribution according to regional needs.

TABLE 1

DISTRIBUTION OF DENTISTS OF U. S. IN 1940

| Region | Actual dentists | Calculated dentists | Calculated dentists per capita |
|---|---|---|---|
| N.E. | 5,038 | 6,058 | 4,512 |
| M.A. | 18,900 | 18,340 | 14,728 |
| E.N.C. | 16,327 | 14,686 | 14,240 |
| W.N.C. | 8,493 | 6,289 | 7,229 |
| S.A. | 5,606 | 8,217 | 9,532 |
| E.S.C. | 2,662 | 5,043 | 5,764 |
| W.S.C. | 3,934 | 4,897 | 6,987 |
| Mt. | 1,911 | 1,857 | 2,219 |
| Pac. | 7,544 | 5,028 | 5,205 |

## AGE DIFFERENCES

The effect of age on the incidence of dental defects might hold considerable significance for the military services, if only from the practical view of how much dental care would be required. When the present data were examined for the purpose of evaluating age differences, few, if any, marked changes were manifest in the age groups under consideration. This could be interpreted as further substantiation of the view that most dental destruction or disposition to destruction occurs in childhood (*5*). When the men were divided into age groups, the youngest group (17–19) appeared to require as much dental care upon entering the service as any age group up to 40. From a practical dental standpoint, therefore, there appears to be no reason for setting a low age limit upon recruits for the services, since about as much time will have to be spent in dental repair at all age levels below 40. As might be expected, the older groups tend to have more dental restorations placed before entering service.

## DISCUSSION

A nationwide shortage of dentists is indicated by the results of this study. The resulting widespread dental neglect is not limited to any region of the country, although rather large regional differences exist in dental attention. These are related to the number of practicing dentists in a region which, in turn, reflects the economic status of the community. The concentration of professional groups according to regional wealth is not unusual. The fact that dentists are so concentrated does mean, however, that they are not distributed according to regional needs. The presence of a large number of dentists in a region, as has been shown, will not assure the population that they will have inherently sound teeth. The past role of dentists in the population under study was apparently to check the advance of caries in teeth rather than to prevent beginning caries.

Most medical and educational advantages are believed to be held by regions with the largest incomes in contrast to the present finding that the incidence of caries is lowest in regions of the country with small wealth. The dental superiority of the southern regions of the country is obscured by the absence of dental care to check the caries which do start. If existing dentists were distributed on a simple per capita basis throughout the country, personnel drawn from the southern regions would require considerably less dental care upon entering military service than those from other regions. A more equitable distribution of dentists would appear to be on the basis of regional dental needs. Thus, the number of dentists in New England, which totaled 5,038 in 1940, would drop to 4,512 if the existing dentists at that time were distributed on a simple per capita basis. With dental needs as the criterion, the redistribution of dentists would cause a rise to 6,058. This consideration does not in any way indicate the number of dentists actually required in New England if adequate dental care were available on the level accepted by the military services. Had adequate civilian care been available throughout the country in the years before the war, fewer dentists would have been required by the services. The number of dentists required in the services is thus not so much a reflection of unusually high standards, as it is a reflection of the lack of dental attention in the civilian population.

In conclusion, the study of naval personnel has shown not only that civilian dental care is not sufficiently available but also that the existing dental care is not distributed where it is most needed. The necessity for directing attention to caries prevention as well as to the repair of damage caused by caries has become obvious.

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# *Association Affairs*

## Call for Papers

*Persons desiring to present papers* at the Boston Meeting of the AAAS and its affiliated societies are requested to notify at an early date the secretaries of the sections and societies before which they wish to report their work. The secretaries will be aided in their acceptance of papers if each speaker will enclose with the notice an abstract describing the purpose of the investigation, the nature of the results obtained, and the relations of the results to earlier investigations. It is not necessary that those presenting papers be members of the Association.

Copy for the *General Program* of the meeting is due in the Washington office of the Association by 21 October; titles of papers should be submitted without delay to the secretaries in order that those accepted may be included in the printed program.

### SECTION SECRETARIES

*Mathematics*—Prof. Raymond W. Brink, University of Minnesota, Minneapolis, Minnesota.

*Physics*—Dr. Joseph C. Boyce, New York University, New York City.

*Chemistry*—Office of the Administrative Secretary, American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington 5, D. C.

*Astronomy*—Dr. Charles C. Wylie, State University of Iowa, Iowa City, Iowa.

*Geology and Geography*—Dr. George W. White, The Ohio State University, Columbus, Ohio.

*Zoological Sciences*—Dr. J. William Buchanan, Northwestern University, Evanston, Illinois.

*Botanical Sciences*—Prof. George W. Martin, State University of Iowa, Iowa City, Iowa.

*Anthropology*—Dr. Marian W. Smith, Columbia University, New York City.

*Psychology*—Dr. Harold E. Burtt, The Ohio State University, Columbus, Ohio.

*Social and Economic Sciences*—Dr. Bruce L. Melvin, 1355 Ingraham St., N.W., Washington, D. C.

*History and Philosophy of Science*—Dr. Raymond J. Seeger, Wetherhill Rd., Washington, D. C.

*Engineering*—Prof. Frank D. Carvin, Newark College of Engineering, Newark, New Jersey.

*Medical Sciences*—Dr. Malcolm Soule, University of Michigan, Ann Arbor, Michigan.

*Subsection on Dentistry*—Dr. Isaac Schour, University of Illinois College of Dentistry, Chicago, Illinois.

*Subsection on Pharmacy*—Dr. Glenn L. Jenkins, Purdue University School of Pharmacy, Lafayette, Indiana.

*Agriculture*—Prof. E. E. DeTurk, University of Illinois, Urbana, Illinois.

*Education*—Prof. D. A. Worcester, University of Nebraska, Lincoln, Nebraska.

## Microbiological Section, Botanical Society of America

*The recently organized Microbiological Section* of the Botanical Society of America, Inc., will meet with the other sections of the Society at Boston on 26–31 December and will hold several sessions devoted to microbiology. Microbiologists wishing to become affiliated with the Section and to present papers at these sessions should communicate with the secretary, K. R. Raper, Northern Regional Research Laboratories, Peoria, Illinois.

# Technical Papers

## Interactions Between Proteins and Azosulfonamides[1]

I. M. KLOTZ and J. M. LONGFELLOW
*Northwestern University, Evanston, Illinois*
O. H. JOHNSON
*Superior State Teachers College, Superior, Wisconsin*

As part of a general study of the interactions of drugs with proteins, an investigation was undertaken of changes produced in the visible absorption spectra of some azosulfonamides in the presence of proteins, particularly bovine serum albumin. Large effects have been observed and may be attributed to the formation of a drug-protein complex.

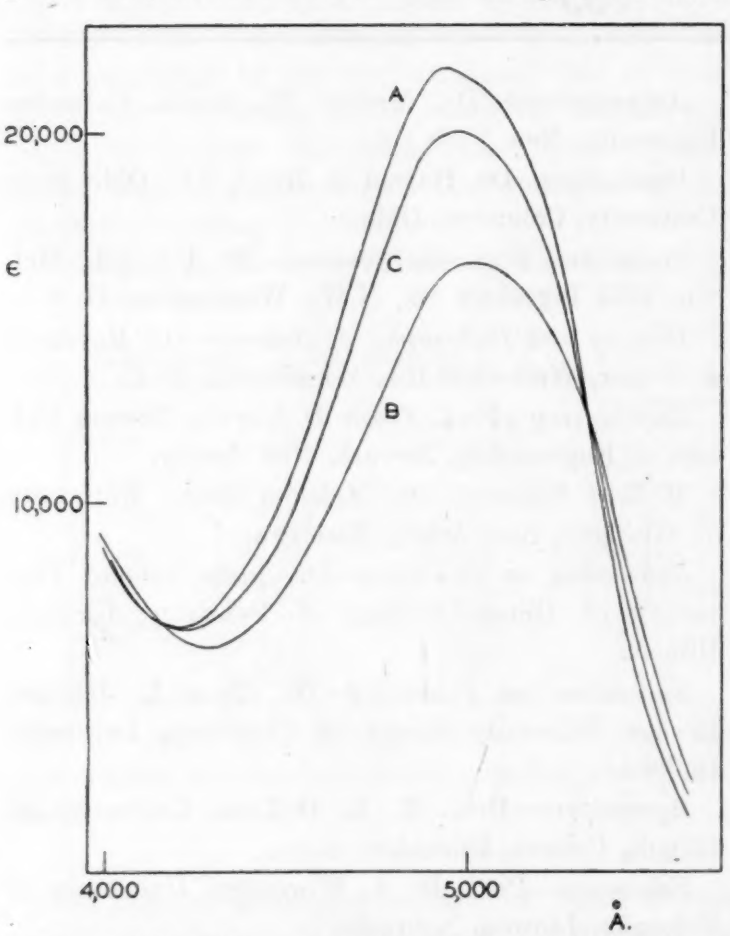


FIG. 1. Absorption spectra of azosulfathiazole in various aqueous media: A, buffer of pH 6.8; B, bovine serum albumin (2 grams/liter); C, $KHC_8H_4O_4$ and bovine serum albumin.

Curve A (Fig. 1) illustrates the absorption spectrum of one of the drugs, azosulfathiazole, in the presence of a phosphate buffer at a pH of 6.8. The same curve is obtained at all pH's from 2 to 9. Similarly, the spectrum is unaffected by the addition of sodium chloride, which alters the electrostatic field of the medium and has been known to change the absorption spectra of other colored anions (*1*).

On the other hand the addition of bovine serum albumin effects a pronounced change in the spectrum of azosulfathiazole, as can be seen in Curve B. Since pH and salt effects have been ruled out, the protein interaction must be due to specific complex-formation with the drug. That the phenomenon cannot be attributed merely to van der Waals' interaction in the presence of large molecules is illustrated by the fact that substances such as sodium dodecyl sulfate (with a molecular weight of 20,000 in the micellar state in aqueous solution, *3*) or Carbowax (a commercial polyoxymethylene polymer with a molecular weight of about 6,000, *2*) have no significant effect on the spectrum of azosulfathiazole.

A change in pH over a range of 4.8–9.2 shows no effect on the spectrum of the complex. Such behavior would indicate that the carboxyl groups of the protein are not involved in the complex-formation but that the quaternary nitrogens in the protein are the focuses of attachment.

That the drug-protein complex is quite strong has been corroborated by an approximate calculation of the first equilibrium constant from shifts in the spectra in solutions of variable protein concentration. These calculations lead to an estimate of $1 \times 10^{-6}$ for K. Such an equilibrium constant corresponds to a free-energy change of about 8,000 calories in the binding process, an energy which indicates that the bond is somewhat stronger than that of a simple hydrogen-bond, probably because of an additional electrostatic attraction between a sulfonic acid anion of the drug and a quaternary nitrogen of the protein.

A very interesting reversal in the spectrum of the complex is observed upon the addition of potassium acid phthalate to the albumin-drug solution (Curve C). Apparently the complex between dye and protein has been largely, though not completely, disrupted. Such behavior would indicate a competition between the phthalate ion and drug ion for some group on the protein, probably a quaternary nitrogen, a competition which is strongly reminiscent of that between *p*-aminobenzoic acid and the simple sulfonamides.

[1] This investigation was assisted in part by a grant-in-aid from the Sigma Xi Research Fund. The authors are indebted also to the Department of Physical Chemistry, Harvard University, and the Armour Laboratories for the recrystallized bovine albumin, to the Winthrop Chemical Company for the azosulfonamides, and to the Du Pont Company for the highly purified sodium dodecyl sulfate.

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# The Relation of Manganese to Internal Bark Necrosis of Apple[1]

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*West Virginia University, Morgantown*

The senior author in 1934 (*1*) suggested the name "internal bark necrosis" for a type of nonparasitic apple-bark disease occurring chiefly on the variety Red Delicious. In 1937 Young and Winter (*4*) stated that the disease apparently was caused by a deficiency of boron. Evidence supporting this view was presented in 1939 by Hildebrand (*3*). The writers have studied this disease intensively in West Virginia for the past six years and have been unable to produce any necrotic lesions or other symptoms typical of internal bark necrosis on the bark of Red Delicious trees grown in boron-free sand culture (*2*). Other symptoms of boron deficiency, such as stunting of the trees, procumbent growth of the twigs, and rosetting, were in evidence. The application of boron to the soil of diseased trees in orchards did not correct the disease.

During the progress of extensive boron analyses it was noted that the ash from diseased tissues (leaves and bark) was always dark, while ash from corresponding tissues of healthy specimens was much lighter in color. Investigation of the mineral constituents in diseased tissues revealed unusually high concentrations of both manganese and iron. The manganese content of severely diseased trees was sometimes 20 times as high as that of normal trees. The iron content, likewise, was usually much higher in the tissues of diseased trees. It was noted that the inner bark of diseased trees, in contrast to that of healthy trees, became discolored almost immediately when exposed to the air.

For a number of years the writers have noted that the disease is most prevalent on acid soils containing appreciable amounts of readily available manganese. In several cases where ammonium sulfate, a soil-acidifying fertilizer, was added to newly planted Red Delicious and Stayman Winesap trees, the trees became severely affected the first season, while the adjacent unfertilized trees showed no symptoms.

During the past six years large numbers of Red Delicious apple whips have been grown each season in the greenhouse in crocks (two-gallon, straight-sided, glazed earthenware jars with a side drainage hole flush with the bottom). One soil, designated as Soil A, was taken from an orchard where the disease is very prevalent. The percentage of trees that became diseased in the greenhouse in this soil varied from year to year. This agrees with the results obtained in parallel orchard experiments. Another soil, designated as Soil B, was taken from a location where the disease has never been known to occur, even though Red Delicious trees have been growing there for the past 20 years. When Red Delicious whips were planted in crocks in this soil, no symptoms of the disease appeared.

For the past three years extensive greenhouse and orchard experiments have been conducted to ascertain the role of manganese and iron in the development of the disease. On 1 June 1943, 54 Red Delicious apple whips were planted in crocks in Soil A and Soil B. All trees were watered with distilled water for the duration of the experiment. After the trees had become established, part in each soil were kept as controls and were not treated. The remaining trees in each soil were given for the season one application of manganese, iron, or a combination of iron and manganese. The iron (24–384 ppm) in the form of iron tartrate and manganese (24–384 ppm) in the form of manganous sulfate in solution were added to the soil. At the end of each growing season all unaffected trees were placed in cold storage for the winter. Each April the trees were returned to the greenhouse. In May 1944 and again in May 1945 each unaffected tree received an application of iron, manganese, or a combination of iron and manganese equal to that given the first season.

By the end of the third growing season (1945) 90.7 per cent of the treated trees and 58.3 per cent of the control trees in Soil A were diseased. On Soil B 54 per cent of the treated trees were diseased, while none of the control trees was diseased. Symptoms in all cases were identical with those observed in the orchard. It is evident that on Soil A the treatments greatly increased the number of trees that became diseased. It was noted also that the symptoms on the treated trees were more pronounced than those on untreated trees.

During the first year only 4.5 per cent of the treated trees, none of the controls on Soil A, and none of the trees on Soil B became affected. The greatest percentage of trees succumbed the second year, these being the trees which had been given the highest concentrations of salts.

The low percentage of diseased trees in Soil A during the first year is attributed to the fact that the experiment was set up too late in the season (1 June) and that the concentrations of iron and manganese applied were not sufficiently high. The writers have noted in both field experiments and greenhouse culture that a long season and ideal growing conditions are conducive to the development of the disease.

[1] Published with the approval of the director of the West Virginia Agricultural Experiment Station as Scientific Paper No. 348.

It is significant also that the disease usually makes its appearance in late summer and early autumn, apparently at the period when there is an acceleration of food accumulation in the bark, and develops with great rapidity after the first symptoms become visible. It has been observed also that the trees most severely affected often have the most vigorous root systems.

In view of these experimental observations a much more extensive experiment using Soil A and Soil B was set up in the greenhouse on 4 April 1945. Fifty-four trees (32 treated; 22 controls) were planted in Soil A. Ninety trees (48 treated; 42 controls) were planted in Soil B. Greater concentrations of iron and of manganese were used (96–1,536 ppm) than in the previous experiment. At all times ideal moisture conditions were provided and as a result the trees made a much more vigorous growth than did those in the previous experiment, which were watered only intermittently so as to approximate orchard conditions.

By the end of the first growing season (1945) 75 per cent of the treated trees and 45.4 per cent of the controls in Soil A were diseased. In Soil B 31 per cent of the treated trees were diseased, and none of the controls was diseased.

From the results so far obtained it is quite apparent that excess manganese and perhaps iron are important factors in the development of the disease, but in order to evaluate the specific effect of manganese, iron, or combinations of manganese and iron, further experiments must be carried out, with trees grown in pure sand culture.

On 21 April 1945 such a preliminary experiment was begun. Red Delicious apple whips cut back to 10 inches were grown in acid-washed sand with the addition of varying amounts of manganese. The basic nutrient solution used was one which the authors have found well suited for the growth of apple trees.[2] For the first three weeks after the trees were planted all trees were supplied with the basic nutrients. Throughout the experiment the control trees received this nutrient solution. The manganese added to the treated trees was increased by doubling the concentrations in geometric progression from 0.5 to 128 ppm.

Within seven days after the manganese treatments were begun the new leaves of the trees began to manifest symptoms of manganese toxicity varying in intensity with the concentration used. At the end of the first growing season the disease developed on all four trees receiving the two highest concentrations of manganese, namely 64 and 128 ppm. In this experiment the disease was unusually severe and occurred both on the old growth and on that of the current season. It is noteworthy that the time of development of the disease in sand culture coincided with the appearance of the disease in other trees grown in crocks in Soil A, whether in the greenhouse or outside, and also with the time of its development in the orchard from which Soil A was taken.

During the last five years the writers have used lime in some field experiments. In April 1945 a greenhouse experiment was begun using Soil A, the soil in which some internal bark necrosis develops. Lime was added to eight crocks of this soil at planting time to decrease the acidity from pH 4.2 to pH 6.5. Of the eight trees grown, none developed the disease. Twenty-two control trees were grown in the same soil without addition of lime, 10 of these developing internal bark necrosis.

The above-described experiments indicate that manganese and perhaps iron are important factors in the development of internal bark necrosis. Further studies, however, are necessary in order to determine what specific role they play in causing this physiological disturbance.

[2] Basic nutrient solution: dihydrogen potassium phosphate, 0.0108 M; calcium nitrate, 0.0078 M; magnesium sulfate, 0.0020 M; ammonium sulfate, 0.0007 M; boron (as boric acid), 2.0 ppm; Fe (as iron tartrate), 6.0 ppm; Zn (as zinc sulfate), 0.2 ppm; Cu (as copper sulfate), 0.1 ppm; and Mn (as manganous sulfate), 0.5 ppm. Nutrients were renewed weekly. Nutrient solution was forced upward twice daily through the sand, allowed to stand 10 minutes in contact with the sand, and then allowed to drain. The trees were grown during the entire period in a greenhouse under whitewashed glass.

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## Two New Effective Insect Repellents, NMRI-201 and NMRI-448[1]


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*Naval Medical Research Institute, Bethesda, Maryland*


A survey of mosquito repellents at the Naval Medical Research Institute revealed two chemicals, 2-phenyl cyclohexanol and β-tetralol (2-naphthol,1,2,3,4-tetrahydro), which were unique because they lost only a relatively small percentage of their activity when applied to the sweating skin of test subjects. A mixture of these chemicals (NMRI-201), consisting of 70 per cent 2-phenyl cyclohexanol and 30 per cent β-tetralol (by volume), was found more effective than either of


[1] Grateful acknowledgment is made to the Insect Control Committee, National Research Council; F. T. vom Baur, of the Office of Inter-American Affairs; Herman Zuniga, of the Salubridad Publica of Venezuela; Daniel Jobbins, of the Pan American Union; S. D. Macready, of United Fruit Company; and the late H. O. Calvery and J. H. Draize, of the Food and Drug Administration, for their cooperation and interest in these studies.


[2] The opinions and statements are those of the authors and not necessarily those of the Navy Department.

the ingredients. Other proportions of these compounds were not as effective as NMRI-201 (Table 1).

During storage tests both tetralol and NMRI-201 developed an orange-red color. Tests against mosquitoes showed that these materials had lost some of their repellent properties. Chemical analysis indicated that oxidation had occurred. In order better to understand these changes, freshly distilled β-tetralol was oxidized in Warburg vessels for varying intervals of time and the repellent activity and color changes of each sample determined. Some correlation between extent of oxidation, amount of chromogen, and repellent activity was noted (Fig. 1).

Since the formation of hydroperoxides appeared to accompany the oxidative changes, β-tetralol with known hydroperoxide content was prepared, varying concentrations being tested against mosquitoes. Again a slight amount of oxidation appeared to improve the repellent quality of β-tetralol (Table 2).

TABLE 1

SUMMARY OF REPELLENCY TESTS AGAINST MOSQUITOES (*Aëdes aegypti*) TO DETERMINE THE MOST EFFECTIVE COMBINATION OF 2-PHENYL CYCLOHEXANOL AND β-TETRALOL

| NMRI No. | Ingredients (% by vol.) | | Average period of complete protection (min.) | |
|---|---|---|---|---|
| | β-tetralol | 2-phenyl cyclo-hexanol | Subjects with dry skin* | Subjects with sweating skin† |
| 164 | 100 | 0 | 361 | 143 |
| 203 | 70 | 30 | 303 | 115 |
| 202 | 50 | 50 | 370 | 122 |
| 201 | 30 | 70 | 451 | 178 |
| 192 | 0 | 100 | 324 | 157 |

* Environmental temperatures: 80° F. dry bulb, 70° F. wet bulb.
† Environmental temperatures: 90° F. dry bulb, 80° F. wet bulb.

TABLE 2

REPELLENT ACTION OF β-TETRALOL OF KNOWN HYDROPEROXIDE CONTENT*

| Unoxidized β-tetralol (ml.) | Oxidized β-tetralol (ml.) | Hydro-peroxide content (% of total) | Average period of complete protection for subjects with sweating skin (min.) |
|---|---|---|---|
| 3.0 | none | none | 116 |
| 2.7 | 0.3 | 0.17 | 144 |
| 2.4 | 0.6 | 0.34 | 165 |
| 2.1 | 0.9 | 0.51 | 129 |
| 1.5 | 2.25 | 1.27 | 199 |
| none | 3.0 | 1.70 | 113 |

* Environmental temperatures: 90° F. dry bulb, 80° F. wet bulb.

As some amount of oxidation seemed desirable, attempts were made to control the process by the addition of certain antioxidants. Hydroquinone and thiourea accomplished the desired effect for a short time, but after five days the antioxidants became saturated with oxygen and the repellent activity decreased (Table 3).

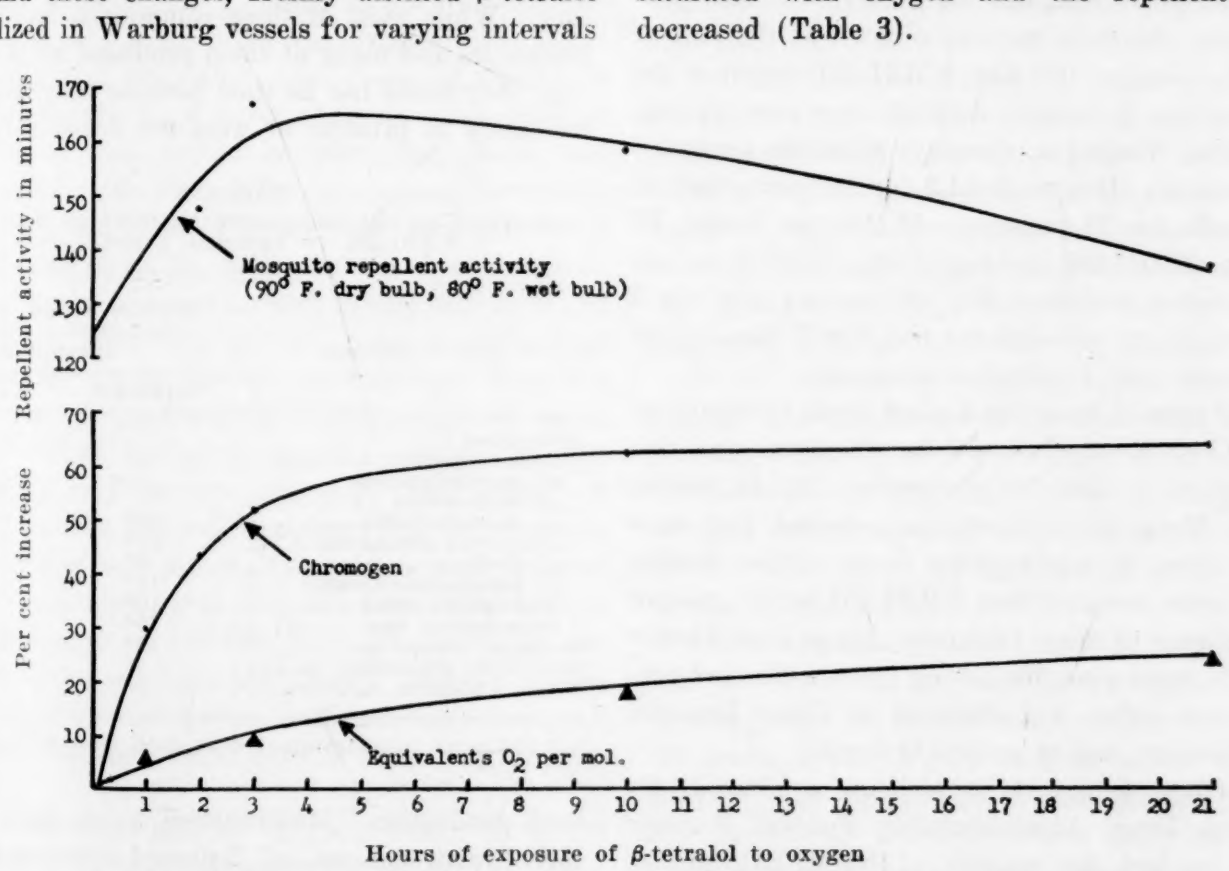


FIG. 1. Comparison between color development and oxidation of β-tetralol and its mosquito-repellent action.

In order to determine the effectiveness of NMRI-201 against a greater variety of insects, samples were sent to several agencies in the United States and in Central America. The first tests were conducted in the jungles near San Juan del Gozo, El Salvador, against the nocturnal mosquitoes, *Anopheles albimanus* and *A.*

*pseudopunctipennis,* and the diurnal species, *Aëdes taeniorhynchus, A. aegypti,* and *A. euplocamus.* In all jungle tests four drops of repellent were applied to the face and neck, four drops to each arm, and six drops to each leg. Four men used NMRI-201, while the fifth, serving as the control subject, applied

TABLE 3

EFFECT OF ANTIOXIDATION ON THE MOSQUITO-REPELLENT ACTION OF β-TETRALOL

| Oxidation of tetralol | | Antioxidant added | Period of complete protection for subjects with sweating skin |
|---|---|---|---|
| Original exposure to $O_2$ (hrs.) | Subsequent exposure to air at 37° C. (hrs.) | (% by wt.) | (min.) |
| 0 | 0 | none | 119 |
| 2 | 44 | none | 139 |
| 2 | 350 | none | 119 |
| 2 | 44 | 1.6 hydroquinone | 177 |
| 2 | 350 | " | 121 |
| 2 | 44 | 1.6 thiourea | 174 |
| 2 | 350 | " | 119 |
| 2 | 44 | 1.6 quinhydrone | 131 |
| 2 | 350 | " | 113 |

2-phenyl cyclohexanol. At night the control subject received the first bite 3 hours after applying the repellent. One person using NMRI-201 was bitten 11 hours after treatment, but the others were still protected when the tests were terminated at the end of 13 hours. During the day NMRI-201 repelled the *Aëdes* spp. for 3½ hours. Against these same species at Managua, Nicaragua, dimethyl phthalate protected for 47 minutes, 2-hexanediol,1,3 for 1½ hours, and oil of citronella for 18 minutes. At Jatepec Island, El Salvador, NMRI-201 protected the user from *A. taeniorhynchus* and sand flies (*Culicoides* sp.) for 5 hours and, in an uncompleted test, for 7 hours from *A. albimanus* and *A. pseudopunctipennis.*

Similar reports from the United Fruit Company at Manila, Costa Rica, confirmed the effectiveness of this new repellent against *A. albimanus.* At Almirante, Panama, *Mansonia titillans* was repelled for more than 5 hours in uncompleted tests. Other studies in these areas revealed that NMRI-201 would prevent the attachment of mites (chiggers) for at least 8 hours and would repel sand flies for 3½ hours. Similar protection from mites was observed at Camp Lejeune, North Carolina, and in central Georgia.

While these field tests were being conducted, the Food and Drug Administration, Federal Security Agency, studied the toxicity of NMRI-201 and of β-tetralol and found that, although acute toxicity tests were generally favorable, NMRI-201 produced some toxicological manifestations upon continued administration to rabbits. Since the same results had been obtained with β-tetralol alone, it was apparent that this compound was the toxic fraction of NMRI-201. However, in view of the extended effectiveness of the repellent, it was concluded that NMRI-201 must be considered for adoption unless primary irritation was of high incidence. From the data on laboratory and field tests, primary irritation to the skin of varying degrees was noted in 6 of the 59 subjects (Table 4).

In view of these findings a substitute for β-tetralol was obviously needed. A series of other naphthol

TABLE 4

INCIDENCE OF SKIN IRRITATION BY REPELLENT NMRI-201

| Location | No. of subjects | Skin response | | | |
|---|---|---|---|---|---|
| | | None | Tingling sensation | Warm sensation | Erythema |
| NMRI | 10 | 8 | 1 | 1 | 0 |
| Palmar, Costa Rica | 2 | 1 | 0 | 0 | 1 |
| Manila, Costa Rica | 25 | 23 | 1 | 1 | 0 |
| Almirante, Panama | 13 | 13 | 0 | 0 | 0 |
| Good Hope, Costa Rica | 1 | 0 | 1 | 0 | 0 |
| Central Georgia | 1 | 1 | 0 | 0 | 0 |
| San Juan del Gozo, El Salvador | 4 | 4 | 0 | 0 | 0 |
| Jaltepec Island, El Salvador | 2 | 2 | 0 | 0 | 0 |
| Managua, Nicaragua | 1 | 1 | 0 | 0 | 0 |
| Totals | 59 | 53 | 3 | 2 | 1 |

derivatives were synthesized and tested in the laboratory. While most of these compounds had repellent properties and many of them produced no skin irritation, they could not be used because they were either too costly to produce or were not feasible for large-

TABLE 5

COMPARISON OF THE REPELLENT ACTIVITY OF NMRI-448 AND NMRI-201 IN TROPICAL FIELD TRIALS

| Species repelled | Average period (hrs.) of complete protection afforded by | |
|---|---|---|
| | NMRI-448 | NMRI-201 |
| Mosquitoes: | | |
| *Aëdes aegypti* | 5 | 3.5 |
| *A. taeniorhynchus* | 5–6 | 3.5–4 |
| *A. euplocamus* | | 3.5 |
| *A. augustivitatus* | 10* | 11* |
| *Anopheles albimanus* | 11* | 11* |
| *A. darlingi* | 9* | |
| *A. pseudopunctipennis* | 10* | |
| *Psorophora ferox* | 10* | |
| *Uranotaenia* spp. | 10* | |
| Bedbugs: *Cimex* sp. | 12* | 12* |
| Sand flies: *Culicoides* sp. | 4* | 3–7 |
| Mites: Chiggers | 8* | 8* |

* Indicates tests terminated at such time without any insect bites.

scale production. Modifications, particularly the further hydrogenations, of 2-phenyl cyclohexanol were then studied. A mixture (NMRI-448), consisting of 70 per cent 2-phenyl cyclohexanol and 30 per cent 2-cyclohexyl cyclohexanol (by volume), was found even more effective than NMRI-201. Further field tests in the tropics have verified these laboratory findings (Table 5).

Although NMRI-448 has not been used by large numbers of persons, no cases of skin irritation have

been observed. Toxicological tests by the Food and Drug Administration are incomplete, but their experiments indicate the likelihood that the compound will be acceptable for application to the skin.

## Passage of the Ring Spot Virus Through Mazzard Cherry Seeds

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Among unbudded Mazzard cherry seedlings in the nursery row occasional seedlings showing ring spot and mottled patterns in their leaves are a common occurrence in western nurseries. When buds were taken from such mottled trees and placed in peach, typical ring spot symptoms, as described by the author (*1*), developed. Although postemergence infection of the seedlings in the nursery row could not be ruled out, the question of seed passage was raised.

In 1943 Mazzard cherry seed was purchased from a western grower who supplies seed to the nursery trade. The seed was taken from a mixed lot collected from stray and pollinator trees scattered through a commercial orchard of sweet cherries. The fruit on the Mazzard trees varied in color, size, shape, and ripening date; the size of the pits was also variable. It is not known whether these trees were planted as pollinators or were the result of sweet cherry on Mazzard rootstock, where the sweet cherry top died and the rootstock grew into a tree. Another lot of seed (supplied by E. L. Reeves) was from a Canadian source tree of Stark's Gold (a large-fruited yellow Mazzard) which had given uniform seedlings without evidence of ring spot symptoms in their leaves. A third lot of seed was collected from a Mahaleb cherry tree which had been previously experimentally infected with the ring spot virus and which had shown characteristic symptoms for two years. A fourth lot was collected from an untreated check Mahaleb cherry which, based on visual symptoms, was virus free. All seeds were stored for 100 days in moist peat at 36°–40° F.

The seeds were planted in ground beds in a lath house at the Citrus Experiment Station in April 1944, and growth proceeded rapidly. By 1 June scattered seedlings in the commercial Mazzard lot were showing leaves with crowded ring patterns. Since the seeds were planted closely, the seedlings became crowded, resulting in dwarfing of some. Counts were made, including only those 6 inches or more in height. Of the 467 seedlings counted, 25 were affected with ring spot. Some of these were strikingly affected with vivid, crowded, chlorotic ring patterns, necrotic rings, shot hole, and lace leaf. Others were less affected with chlorotic spots, rings and concentric rings, and oak-leaf patterns. In all cases the size of the rings was in inverse proportion to the number present—the greater the number, the smaller the diameter. No evidence of ring spot was seen in 90 seedlings resulting from the Stark's Gold seed, in 167 seedlings from the Mahaleb experimentally infected with ring spot, or in 120 seedlings from the visually healthy Mahaleb tree. Since these seedlings were grown in the same bed, they serve as a check to show that the Mazzards were not infected from an outside source.

In October 1944, 6 of the 25 Mazzard seedlings showing ring spots were selected, and 2 buds from each placed in each of 2 Hale peach nursery trees. A parallel series was set up with buds from 6 of the Mazzard seedlings showing no evidence of ring spot. In April 1945, 7 of the 12 peach trees inoculated, and representing 5 of the 6 symptom-bearing Mazzards, had developed typical ring spot but varied in type and severity with the different source seedlings. Most of the infected Mazzard inoculum buds died shortly after insertion, which may account for failure of infection in 5 of the Hale peach trees. It is also possible, since the Hale peach nursery stock was obtained on the open market, that the 5 trees failing to develop symptoms were already carrying the ring spot virus and would develop no symptoms following inoculations. None of the peach trees budded from normal-appearing Mazzard seedlings developed any symptoms of ring spot, although all bore living Mazzard buds.

All of the cherry seedlings were moved to the nursery row and observed for symptoms during the growing season of 1945. Twenty-four of the original 25 Mazzards showing rings survived, about one-half of them developing good ring spot symptoms. None of the remainder of the Mazzards or of the other lots developed any ring spot.

It thus appears that the ring spot virus can invade and be carried in Mazzard cherry seeds. Since the Mazzard seed lot was a sample taken directly from the trade, it should give some indication of the percentage to be expected from seed gathered at random. The amount of the seed in this study coming from trees infected with ring spot is not known nor is the percentage of ring spot which would result if the seed were taken from a single infected tree.

Seed passage helps to explain the wide occurrence of this virus in both sweet and sour cherries. Although only a relatively few of the seeds were infected, these were sufficient to provide for widely scattered distribution in nursery stock propagated on

Mazzard and from which spread could later take place in the orchard. Once well distributed in orchard trees where in many varieties it is latent or nearly so, the virus is further distributed through varietal bud and scion wood. Milbrath and Zeller (*2*) report a nearly universal occurrence of latent virus in both sweet and sour cherries in Oregon. Moore and Keitt (*3*), working with sour cherry yellows, report all their sources of this virus to be contaminated with necrotic ring spot. Further evidence pointing to cherry as a reservoir of this virus, in which a more uniform distribution is perhaps an indirect result of seed distribution, is the lesser occurrence of the virus in other stone fruits in districts where cherries are not grown. The virus is rare in peach in Texas and extremely rare in peach in the southeastern United States.

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# News and Notes

## About People

*Wilmer Souder* has been appointed chief of the Metrology Division, formerly the Division of Weights and Measures, of the National Bureau of Standards. Associated with the Bureau for 31 years, Dr. Souder developed the Dental Research Laboratory and the Identification Research Laboratory.

*M. W. Jennison* has been appointed professor of bacteriology, in charge of the Division of Bacteriology, Department of Plant Sciences, College of Liberal Arts, at Syracuse University, effective in September.

*John D. Ferry,* assistant professor of chemistry at the University of Wisconsin, has been awarded the $1,000 Eli Lilly and Company prize by the American Chemical Society, for outstanding achievement in biochemistry. Dr. Ferry was cited for "versatile and incisive studies on the chemistry, especially the physical chemistry, of large molecules."

*James G. Betrem,* formerly of Java and known for his work on Scoliidae, writes that he was a prisoner of war of the Japanese for three and one-half years but was eventually freed in good health. His wife died in another camp. He is at present on leave in Bussum, Netherlands. During his leave he has been instructed by the Government of the Dutch East Indies to study the newest developments in insect control, especially DDT and gammexane.—*J. C. Bradley.*

*David R. Miller,* chief of the Gage Section, National Bureau of Standards, has been appointed assistant chief of the Bureau's Metrology Division.

*W. O. Milligan,* assistant professor of chemistry at the Rice Institute, Houston, Texas, received the Doctor of Science degree from Illinois College on 16 June.

*William C. Young* has been made associate professor of anatomy in the University of Kansas Medical School, Lawrence, effective in September.

*Fred J. Kelly* retired from his position as chief of the Division of Higher Education of the U. S. Office of Education at the end of June.

*Carl J. Christensen,* of the Bell Telephone Laboratories technical staff, has been appointed dean of the School of Mineral Industries, University of Utah. Dr. Christensen, associated with the Bell Laboratories since 1929, has been in charge of metallurgical research. The School of Mineral Industries is being created by a division of the present School of Mines and Engineering. A. LeRoy Taylor will continue as dean of the School of Engineering.

*William S. McCann,* head of the Department of Medicine, University of Rochester School of Medicine and Dentistry, has been appointed vice-chairman of the American Board of Internal Medicine. He has also been appointed a member of the Board of Regents of the American College of Physicians, Philadelphia, for a term of three years.

*James H. Bywaters* has returned to the U. S. Regional Poultry Research Laboratory, East Lansing, Michigan, as geneticist after serving more than four years in the Ordnance Department, U. S. Army.

*Edgar N. Transeau,* chairman of the Department of Botany, The Ohio State University, will retire on 1 October after 30 years of service. Prof. Transeau has been head of the Department since 1918 and director of the Botanical Garden at Ohio State since 1930. He is a past president of the Botanical Society of America, the Ecological Society of America, and the Ohio Academy of Science.

## Announcements

*The Department of Physiology and Hygiene* of Goucher College, Baltimore, the oldest separate Department of Physiology in a woman's college, recently celebrated its 30th year as a major department. As a part of the program Florence B. Seibert, an alumna of the College, spoke on some of her recent research on tuberculosis.

*The National Registry of Rare Chemicals,* Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois, indicates that the following chemicals are needed: azulene, erythrulose, formoguanamine, pyrrolidone, stilboestrol mono glucoside, dihydroergotamine, nobiletin, scutellarein, wogonin, calycopterin, epicatechin, nortangeretin, baicalin, herbacetin, carbamyl chloride, arachidonic acid, ethylene sulfide, ergothionine, thiol histidine, and *s*-tetroxane. Communications regarding these should be directed to the Registry at the address given above.

*The Clinton G. Abbott Memorial Publication Fund* has been set up by the San Diego Society of Natural History in appreciation of the late Dr. Abbott's work as director of its Museum over a period of 24 years. All contributions are to be invested, and the interest will be used to finance the enlarged publication program of the Society. Friends and admirers of Dr. Abbott are invited to send contributions, payable to the San Diego Society of Natural History and marked "Abbott Memorial Fund." These should be mailed to Arthur C. Wells, Treasurer, c/o The San Diego Trust and Savings Bank, 540 Broadway, San Diego 1, California.

*The University of Michigan* has announced the following promotions to full professorships: Horace Richard Crane, physics; Paul Sumner Dwyer, mathematics; Chester Baker Slawson, mineralogy; James Sherman Gault, electrical engineering; and Louis Charter Schultz, dentistry.

*The Department of Bacteriology, University of Tennessee,* has received a renewal of a research grant from Sharp and Dohme, Inc. This grant affords increased financial support to a research program under the direction of D. Frank Holtman, professor of bacteriology, who is conducting an extensive study to determine the value of certain sulfonamides in the treatment of fowl typhoid.

*A letter from Béla Balogh,* Department of Anthropology, University of Debrecen, Hungary, received by the Editorial Office of *Biological Abstracts,* reports that scientists in Hungary are living in conditions of extreme privation, but efforts are being made to continue research activity. The Anthropological Institute of the University requests reprints, periodicals, and books in physiological anthropology and related fields.

*A bulletin listing 400 films on chemistry* has been issued by the American Chemical Society as a guide to teachers, scientific organizations, and other users of educational films. The bulletin, entitled *Films on chemical subjects—1946* and compiled by William B. Lodder and Olive Noble, of the Society's staff, gives a brief description of each picture and tells where it may be rented or borrowed. The films are grouped by subjects, ranging from abrasives and agricultural chemistry to water and wood. Single copies of the bulletin may be obtained free from the Society's headquarters, 1155 16th Street, N.W., Washington 6, D. C.

*A letter from Pasquale Pasquini,* director, Institute of Comparative Anatomy and Physiology, University of Bologna, received in the Editorial Office of *Biological Abstracts,* states that because of the extremely high printing costs, publication of many of the Italian research journals has been suspended and some time will presumably elapse before these can again appear. Dr. Pasquini reports that his institution is greatly in need of American research journals, particularly in anatomy, embryology, and general physiology, and that reprints in these fields would be deeply appreciated.

*The Southern Station of Yale Observatory,* on the grounds of the University of the Witwatersrand, Johannesburg, South Africa, will hereafter be operated jointly by the Astronomy Departments of Yale and Columbia Universities and will be known as the Yale-Columbia Southern Station. Jan Schilt, Rutherford professor of astronomy, Columbia University, and Dirk Brouwer, director of the Yale University Observatory, are codirectors of the Station. Cyril Jackson, formerly connected with the Union Observatory, Johannesburg, will be in charge of its operation. The Columbia astronomers will undertake research in the fields of stellar photometry, while the Yale astronomers will continue their astrometric studies.

## Elections

*The Association of Southeastern Biologists* held its seventh annual meeting at the University of South Carolina, Columbia, on 19–20 April, with President Mary S. MacDougall, Agnes Scott College, presiding. Twenty-four papers were given, either by reading or presentation. A feature of the meeting was a symposium on the teaching of biology in colleges. Thirty-nine new members were elected. Officers elected were:

James T. Penney, University of South Carolina, president; Martin D. Young, U. S. Public Health Service, Columbia, president-elect; Elon E. Byrd, University of Georgia, vice-president; and Samuel L. Meyer, Emory University, secretary-treasurer. Executive Committee members are: Herman Kurz, Florida State College for Women; Clinton L. Baker, Southwestern College; H. J. Wallace, University of Florida; and Margaret Hess, Winthrop College.

*Ross G. Harrison,* emeritus professor at Yale University and formerly chairman of the National Research Council, has been elected correspondent of the Academy of Sciences of the Institute of France.

*The Association of Schools of Public Health* has recently elected Gaylord W. Anderson, director of the School of Public Health, University of Minnesota, as its new secretary-treasurer.

*Normand L. Hoerr,* Western Reserve University School of Medicine, 2109 Adelbert Road, Cleveland 6, Ohio, has been elected secretary-treasurer of the American Association of Anatomists for a four-year term. All Association correspondence should be addressed to Dr. Hoerr.

## Recent Deaths

*Curt Herbst,* 80, formerly director of the Zoological Institute at the University of Heidelberg, died on 9 May.

*George Grant Hedgcock,* 82, formerly senior pathologist in the Bureau of Plant Industry, Soils, and Agricultural Engineering, died on 11 May. He was known for his work on crown gall of apple and on diseases and decays of timber trees, especially smelter injury and the rust fungi on conifers.

*Franz Knoop,* 71, formerly head of the Institute of Physiological Chemistry, University of Tubingen, died on 2 August in Württemberg, Germany.

*Trustin E. Perry,* acting assistant professor of geology, Tulane University, was killed in an automobile collision on 24 August near Baldwin, Louisiana.

*Gellert Alleman,* 75, professor emeritus of chemistry, Swarthmore College, died on 6 September in Wallingford, Pennsylvania.

*Jaroslav Drbohlav,* 53, professor of bacteriology, Charles University, Prague, and director of the Czechoslovak Health Institute Diagnostic Service, died on 11 August.

*John A. Miller,* 86, formerly head of the Departments of Astronomy and Mathematics at Swarthmore College and president of the College for six years before he retired in 1936, died in Wallingford, Pennsylvania, on 15 June.

## Army Institute of Pathology and American Registry of Pathology

What is now known as the Army Institute of Pathology was established in 1863 as the Army Medical Museum. During World War II the activities of the Institute were greatly expanded, especially in the field of diagnostic pathology and research. There are now on file over 170,000 accessions. The results of research at the Institute during the past few years will be published in a volume of about 1,400 pages as a part of the official history of World War II. The present director is Col. J. Earl Ash, who will be succeeded on 1 October by Col. Raymond O. Dart.

On request of Maj. Gen. Norman T. Kirk, The Surgeon General of the Army, the Committee on Pathology of the Division of Medical Sciences, National Research Council, in late 1945 prepared a report on the future development of the Institute. The report has been approved by both The Surgeon General and the War Department.

The essential recommendations in this report are: (1) that a new building of adequate size be constructed; (2) that the Institute be organized in four divisions—Department of Pathology, Army Medical Illustration Service, Army Medical Museum, and American Registry of Pathology—each headed by a competent specialist; (3) that the staff of the Institute be drawn from both the commissioned ranks of the Army and the civilian professions; (4) that a comprehensive educational and training program be undertaken; (5) that the vast store of material at the Institute be used for research; and (6) that the services in pathology in the Veterans' Hospitals be centralized at the Institute.

The American Registry of Pathology, founded in 1922, thus is and will continue to be an integral part of the Institute. On 1 January 1946 there were over 43,000 cases registered. To effectuate the new plans as they relate to the Registry, the Division of Medical Sciences, National Research Council, appointed a Committee on the American Registry of Pathology, the members of which are: Howard T. Karsner (chairman), Cleveland; Col. J. E. Ash, Washington; Brig. Gen. George R. Callender, Washington; Col. Baldwin Lucké, Philadelphia; Robert A. Moore, St. Louis; Benjamin Rones, Washington; A. R. Shands, Jr., Wilmington; and Henry A. Swanson, Washington.

At the present time the American Registry of Pathology comprises 14 registries, which include: Registry of Ophthalmic Pathology, established in 1922,

sponsored by the American Academy of Ophthalmology and Otolaryngology; Lymphatic Tumor Registry (1925), sponsored by the American Association of Pathologists and Bacteriologists; Bladder Tumor Registry (1927), Kidney Tumor Registry (1940), and Prostatic Tumor Registry (1943), sponsored by the American Urological Association; Registry of Dental and Oral Pathology (1933), sponsored by the American Dental Association; Registry of Otolaryngological Pathology (1935), sponsored by the American Academy of Ophthalmology and Otolaryngology; General Tumor Registry (1937), sponsored by the American Society of Clinical Pathologists; Registry of Dermal Pathology (1938), sponsored by the American Academy of Dermatology and Syphilology; Chest Tumor Registry (1942), sponsored by the American Society of Thoracic Surgeons; Registry of Neuropathology (1943), sponsored by the American Association of Neuropathologists; Registry of Orthopedic Pathology (1943), sponsored by the American Academy of Orthopedic Surgeons; Registry of Veterinary Pathology (1944), sponsored by the American Veterinary Medical Association; and Registry of Gerontology (1945), sponsored by the Gerontological Society, Inc. Plans for additional registries are under consideration.

A professional scientific society wishing to sponsor a registry should communicate with the Director, Army Institute of Pathology, 7th Street and Independence Avenue, S.W., Washington 25, D. C. A society appoints a committee to work with the director in supervision of the activities of the registry and makes an annual contribution to the budget, which is administered by the National Academy of Sciences.

All specimens in the Registry are available for review and research by competent investigators. Sets of slides and accompanying syllabuses on special fields are available for loan to the civilian professions and officers in the Federal services. Physicians, dentists, and veterinarians are urged to send unusual specimens together with an abstract of the history to the Registry. The contributor receives a report on each specimen and is asked to keep the Registry informed of the follow-up on the patient.

With the reorganization of the Army Institute of Pathology, to be completed during 1946 and 1947, a full-time scientific director of the American Registry of Pathology will be appointed, and sufficient clerks and technicians will be available to assure adequate use of the registries for diagnosis, research, training of young men, and education of the professions.

# *In the Laboratory*

## The Composition of Streptomycin Reineckate

J. Fried and O. Wintersteiner

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In a previous publication (*2*) we briefly described a crystalline reineckate of streptomycin which was obtained from highly purified preparations of streptomycin sulfate, and the analyses of which suggested the composition $(C_{10}H_{19}O_{7-8}N_3)n$ for the free base. This is not in accord with the formula $C_{21}H_{37-39}N_7O_{12}$, which was subsequently deduced by Peck, *et al.* (*3*) from the analysis of the crystalline hydrochloride-calcium chloride double salt. Since the latter formula has since received support from degradation studies (*1*), a reinvestigation of the composition of the reineckate was undertaken. It was found that in all specimens of the reineckate crystals which had been prepared from streptomycin sulfate a small but constant proportion of its total sulfur content was present as sulfate ion. Thus, three independently prepared and recrystallized samples showed a sulfate content of 3.41, 3.54, and 3.85 per cent, respectively. It therefore appears that sulfuric acid is an integral part of reineckate crystals derived from streptomycin sulfate. Recalculation on this basis of the analytical data previously published (*2*) as well as of the analyses of recently prepared specimens showed that the data are in accord with the formulation $(C_{21}H_{37}O_{12}N_7)_2 \cdot 4(HCr(SCN)_4(NH_3)_2) \cdot H_2SO_4$, indicating that this type of reineckate represents a double salt of the base with two molecules of Reinecke's acid and one equivalent of sulfuric acid. Thus, the complete analysis of a new specimen gave the following values: Found: C, 27.06; H, 4.50; N, 20.8; total S, 21.2; $SO_4$, 3.54; Cr, 8.20. Calculation for above formula: C, 27.45; H, 4.29; N, 20.96; total S, 21.43; $SO_4$, 3.79; Cr, 8.20. While it is true that on account of the encumbrance by the Reinecke's acid portion the carbon and hydrogen numbers cannot be deduced accurately from the experimental data, there is no question now that the composition of the reineckate is compatible with the formulation of the free base as $C_{21}H_{37}O_{12}N_7$.

In view of the composite nature of the salt a brief

description of its preparation and of the appearance of the pure crystals may not be superfluous. A freshly

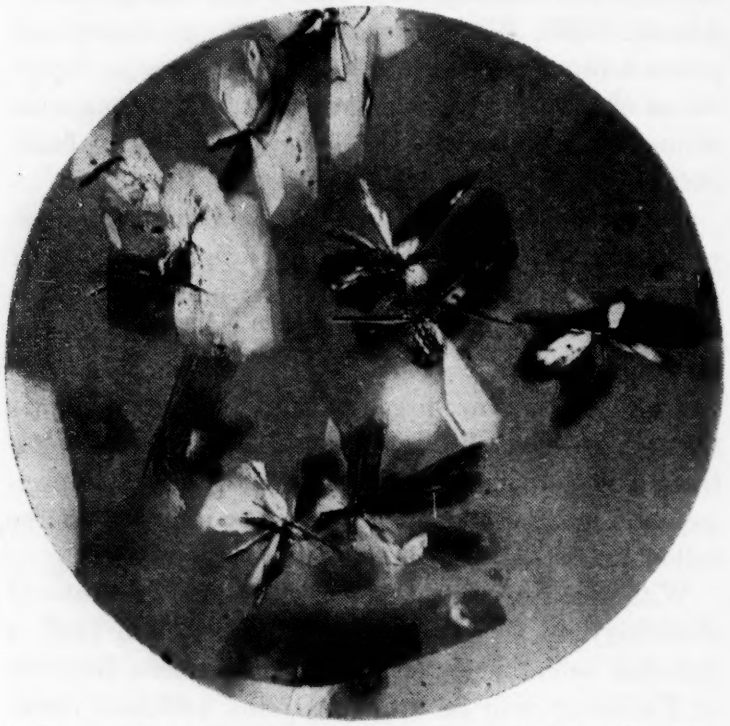

FIG. 1. Streptomycin reineckate sulfate viewed under polarized light. Magnification: 90 ×.

prepared solution of ammonium reineckate (300 mg.) in water (16 cc.) was added to water (5 cc.) containing streptomycin sulfate (230 mg.; potency, 600 units/mg.). Both solutions were warmed to 40° before mixing. A small amount of an amorphous precipitate was removed by filtration and the filtrate allowed to cool very slowly to about 20°. After collecting the resulting crystalline deposit, the filtrate was cooled slowly to 4° and yielded an additional crop of crystals. Recrystallization of the fractions from warm water (not above 40°) yielded very thin, long (1–2 mm.) plates of the habitus shown in Fig. 1. If starting material of lower potency is used, several recrystallizations may be necessary until clear-cut crystals of this size and appearance and possessing a potency of approximately 400 units/mg. can be secured.

Various specimens of streptomycin hydrochloride, including substantially pure streptomycin trihydrochloride, when treated with ammonium reineckate, as described above, likewise yielded crystalline products. However, recrystallization under conditions identical with those employed in the purification of the reineckate sulfate produced aggregates of small, needle-shaped forms which were generally less well defined than the large plates exemplified in Fig. 1. These preparations were found to be free of chloride ions. The analytical composition of a preparation derived from the pure trihydrochloride was significantly different from those of the reineckate sulfate. With the exception of the low-nitrogen and chromium figures, the data would seem to speak for a trireineckate of $C_{21}H_{37}O_{12}N_7$: Found: C, 26.13; H, 4.28; N, 22.0; S, 24.8; Cr, 9.38. Calculation for $C_{21}H_{37}O_{12}N_7 \cdot 3(HCr(SCN)_4(NH_3)_2)$: C, 25.79; H, 3.80; N, 22.77; S, 24.99; Cr, 10.15.

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## Infrared Emission Spectra of Liquids[1]


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Although the characteristic infrared absorption spectra of organic liquids are well known, the corresponding emission spectra do not appear to have been reported. The failure to find emission spectra may arise from the use of too great a thickness of liquid. Just as a thick layer is entirely opaque to the infrared, so a thick layer of hot liquid emits only black body radiation. When the layer of heated liquid is thin enough to be partially transparent in the wave

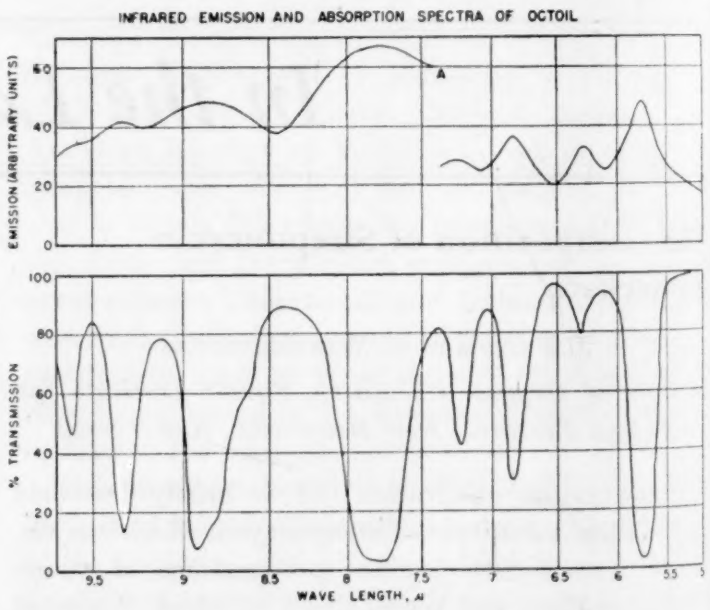


FIG. 1

lengths under study, the liquid emits characteristic bands which are the exact inverse of its absorption bands.

This concept has been confirmed with the liquid di(2-ethyl-hexyl)phthalate (octoil) in a cell .001 inch thick held at temperatures of 50–200° C. with a Perkin Elmer Infrared Spectrometer at slit widths of .500–.700 mm.

The results are shown in Fig. 1, which gives a plot of the emission (at 150° C.) and absorption curves.

[1] Communication No. 103.

Point A on the emission curve indicates a change in slit width from .500 to .700 mm. The exact equivalence of the positions of the absorption and emission bands is at once evident.

The specific bands, and indeed the whole spectrum, become more intense as the temperature is increased. It has been tentatively established that the emission at any given wave length as a function of temperature follows Wien's Law, $J = A \exp(-c/\lambda T)$. However, the constants are different for different wave lengths, since we are far from the black body conditions to which the general law applies.

The emission spectra offer a new means of study of the liquid state and should prove a useful analytical tool. Extension of the method to determining emission bands at room temperature using a cold receiver is an intriguing possibility.

Further data and experimental details are being prepared for publication.

## Dropping Device for Cylinder Plate Assay of Penicillin

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and
ROBERT D. SHAW
*Bloomfield, Connecticut*

The efficacy of the cup-plate method of assay has been widely established, particularly for estimating potencies of antibiotics. It is the official method for the determination of potencies of penicillin products subject to certification under Federal law. Briefly, the method requires a hardened, seeded agar layer in a standard Petri dish upon which sterile cylinders are placed vertically. The solutions under test are pipetted into the cylinders and the Petri dish incubated at the optimum temperature of the test organism for a suitable length of time. The test solution diffuses through the agar surrounding the cylinder, inhibiting the growth of the organism in that area, resulting in a clear zone in an opaque field. The diameters of the clear zones are measured by suitable devices, and, by comparison with zones produced by standard solutions on the same plate, the potencies of the test solutions are computed.

The actual placing of the cylinders upon the agar surface is a procedure of major import in this test. It is imperative that the agar adjacent to the area occupied by the cylinder shall not be broken and that the cylinders fall onto the agar surface from a constant height, since it has been shown that the gravity drop of the cylinder determines the depth through which it sinks into the agar and variations in the depth result in variations in zone diameters. Efficient manual manipulation to control these factors is impossible. Employment of such devices as the plastic cylinder guide (*1*) is impractical from the standpoint of time when large numbers of plates are required.

One of us (R.D.S.) has developed a mechanism which seats four or six sterile cylinders simultaneously upon the agar surface, evenly spaced, from exactly the same height. The Petri dish, containing the hardened, seeded agar layer, from which the porcelain cover has been removed, is set upon the tray (A) of the dispenser as guided by the pins thereon. Lever (B), as shown in Fig. 1, is then depressed, causing the tray and dish to be lifted approximately one inch. At this moment lever (C) is shifted first to the left and then released to discharge the cylinders simultaneously from the metal tubes (D). The cylinders drop approximately one-half inch and seat themselves firmly on the upper surface of the agar. The tray is then lowered, the Petri dish removed, and the porcelain cover replaced. Employing this device, a technician "cups" an average of 10 plates per minute, whereas it requires four times that interval to "cup" the plates manually.

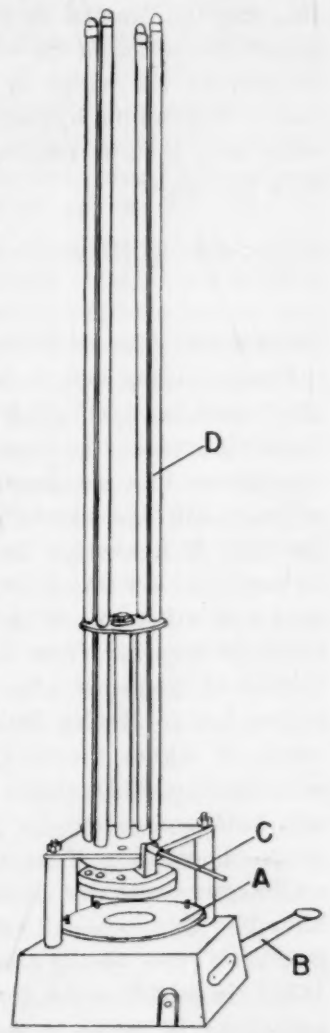

FIG. 1. Penicillin cup-dropping device.

The mechanism is of metal construction, permanently mounted on a heavy metal base five inches square and two inches in height. Over-all height, with the tubes in place, is approximately 30 inches. The distance of the drop of the cylinders is adjustable. The cylinders are stacked in the metal tubes, which hold approximately 60 cylinders each, sterilized and cooled previous to use.

The novel features can be applied in placing other articles or substances on dishes of other forms and sizes. Considerable variation of the mechanism is possible in minor details, proportions, and materials.

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# Letters to the Editor

## On Printing Wings of Insects for the Study of Venation

The wing to be printed is placed between two glass slides, being careful that all folds are pressed out. A drop of alcohol will facilitate smoothing out wings that have a tendency to fold. Labels may be prepared by writing on the glass slide with India ink. The slide is then used as an ordinary negative, placed in a photographic enlarger, and printed on sensitive photographic paper in the usual manner. The length of exposure will depend upon the type and thickness of the wing being printed.

All clear or transparent wings, such as those belonging to the orders of Diptera, Hymenoptera, Homoptera, etc., may be treated in this manner. It is possible to remove the scales on the wings of some of the Lepidoptera by soaking the wings in glacial acetic acid or concentrated ammonium hydroxide for about 24 hours. The scales may then be removed by gently brushing them off with the finger.

DARRELL T. SULLIVAN
*Department of Horticulture, University of Georgia*

## Newton and Applied Mathematics

In the leading article entitled "On the problem of applied mathematics" (*Science*, 1945, 102, 315–320) J. H. Taylor discusses the formulation of Newton's Law of Gravitation in a paragraph beginning in the first column of page 319 and extending into the second. Although the type of discussion leading up to the formulation of an empirical law which Dr. Taylor outlines has often been used and will continue to be useful in the future, it certainly is very far from that followed by Newton in his *System of the world*. Newton himself credits the inverse square law to Hooke, Halley, and Wren; but he, in the words of Agnes Clerke (*Encyclopedia Britannica*, 14th ed., Vol. 2, p. 585), "was the only man of his generation who both recognized the law and had power to demonstrate its validity," by combining results obtained by astronomers with the dynamical principles developed by himself. One may call attention to Richard Stevenson's *Newton's lunar theory exhibited analytically* (Cambridge, 1834), in which is set forth a demonstration in modern notation. It seems to me that this or Newton's treatment in his *System of the world* would have served Dr. Taylor even better than his own discussions in exhibiting a contrast between mechanics and economics.

EDWIN B. WILSON
Written from *University of Glasgow*

## Prior Use of the Rutherford Unit

Referring to the letter of S. C. Lind (*Science*, 1946, 103, 761) regarding the suggestion of E. U. Condon and F. L. Curtiss (*Science*, 1946, 103, 712) that the term "rutherford" be given to a unit expressing the strength of radioactive sources, allow me to point out that in a paper entitled "The sub-microscopic structure of matter" (*Colloid chemistry, theoretical and applied*. Vol. I. New York: Chemical Catalog Co., 1926), a table appears on pages 14–15 containing a chart, showing sizes of various material units at various magnifications. In this, the term "Rutherford Unit" is defined as "1,000,000 μμ or 100,000 Angström Units." An explanatory footnote states:

> In dealing with the extremely minute sizes involved in describing nuclear diameters, it is convenient to use a term of measurement one million times smaller than 1 μμ. This I have termed a "Rutherford Unit" (R.U.), and therefore
>
> $$1 \text{ R.U.} = \frac{1}{100{,}000} \text{ A.U.} = \frac{1}{1{,}000{,}000} \text{ μμ.}$$

Since one of the greatest of Lord Rutherford's many achievements was the demonstration of the nuclear atom, it still seems to me that it is most appropriate that his name be connected with the atomic nucleus. The nucleus is the source of the tremendous energy released by what is erroneously called the "atomic" bomb, and the nucleus and its internal structure are under intensive study involving sizes conveniently expressed in R.U. as above defined, with the exception that in present-day notation μμ is written mμ.

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*50 East 41st Street, New York City*

## An Improved Synthesis of N-Methyl-L-glucosaminic Acid

The recent discovery that N-methyl-L-glucosamine (F. A. Kuehl, Jr., E. H. Flynn, F. W. Holly, R. Mozingo, and K. Folkner. *J. Amer. chem. Soc.*, 1946, 68, 536), exists as a component of streptomycin calls attention to the fact that there is no satisfactory method for its preparation. Following Fischer and Leuchs' (*Ber.*, 1902, 35, 3787; 1903, 36, 24) classical syntheses of the enantiomorphous forms of glucosaminic acid, Votoček and Lukeš (*Coll. Czech. Chem. Commun.*, 1935, 7, 424; *Chem. Listy*, 1935, 29, 308) prepared N-methyl-D-glucosaminic acid by treating an aqueous solution of D-arabinose with methylamine and hydrogen cyanide. They allowed this mixture to stand for a period of three weeks, removed the resultant tar, and then hydrolyzed successively with acid and base to produce, after acidification, an unspecified yield of the amino acid. Folkers and co-workers have stated that the same general method was applied to L-arabinose to yield the enantiomorphous N-methyl-L-glucosaminic acid. We have found that, by operating in anhydrous ethanol instead of in water, the reaction is greatly improved, and both the N-methylamine derivative and the cyanohydrin are readily isolable in crystalline form. Treatment of a suspension of L-arabinose in absolute ethanol with dry methylamine yielded L-arabinosyl-N-methylamine—m. p. 118–120°, $[\alpha]_D^{20}$ D + 43° (initial) → + 51° (60 min., water). Treatment of this compound, or of a mixture

of L-arabinose and methylamine, in absolute ethanol with anhydrous liquid hydrogen cyanide led to the ready crystallization of N-methyl-L-glucosaminic acid nitrile—m. p. 113°, $[\alpha]^{25}$ D −17.5° → −21° (50 min.) → −8.3° (final, water); pentacetate—m. p. 132–134°, $[\alpha]^{23}$ D −38° (chloroform). On hydrolysis of the nitrile with acid followed by base there was obtained, on acidification, N-methyl-L-glucosaminic acid—m. p. 236° (dec.), $[\alpha]^{24}$ D −4.6° (water). From the mother liquors of the nitrile there was isolated an amorphous product which on hydrolysis led to a crystalline acid now under further investigation.

Full details will be communicated at a later date.

M. L. WOLFROM, ALVA THOMPSON, and I. R. HOOPER
*Department of Chemistry, The Ohio State University*

## The Rh System in the Chimpanzee

A. S. Wiener and M. Wade (*Science*, 1945, 102, 177) have shown that the erythrocytes of chimpanzees do not absorb the Rh agglutinins from the human antisera, anti-$Rh_o$, anti-Rh′, and anti-Rh″, but do absorb the agglutinin from the anti-Hr serum. As this parallels the behavior of the human Rh− cells, it is concluded that chimpanzees are Rh−.

A chimpanzee died recently in the Gardens of the Zoological Society of London, and through the kindness of Prof. E. Hindle and Col. A. E. Hamerton we were provided with a sample of the blood. Absorption tests with the chimpanzee blood were clear cut and confirmed the findings of Wiener and Wade; that is to say, in the language of Fisher's theory (cited by R. R. Race. *Nature, Lond.*, 1944, 153, 771; R. A. Fisher and R. R. Race. *Nature, Lond.*, 1946, 157, 48), anti-D, anti-C, and anti-E agglutinins were not absorbed, but anti-c was. We found, however, that the chimpanzee cells failed to absorb the anti-e agglutinin, recently discovered by one of us (A. E. Mourant. *Nature, Lond.*, 1945, 155, 542).

The antigen e is present in double dose on human Rh− red cells, which strongly absorb anti-e. In terms of Fisher's theory the failure to absorb either anti-E or anti-e means that the chimpanzee possesses neither of the antigens determined by the E-e locus in man. Either the chimpanzee possesses a third antigen determined by the same locus or, more probably, the locus is absent altogether.

The apparent separability of this group of Rh antigens would seem to support Fisher's belief that they are, in fact, controlled by a separate locus.

A. E. MOURANT and R. R. RACE
*Galton Laboratory Serum Unit, Medical Research Council Emergency Blood Transfusion Service*
*Cambridge, England*

## Misuse of the Linnaean System of Nomenclature

A. Byron Leonard (*Science*, 1946, 104, 17) has recently criticized under this same heading certain nomenclatural usages of E. E. Dickerman and in doing so has himself so misused the Linnaean system of zoological nomenclature (as codified in the Règles Internationales de la Nomenclature Zoologique) that a protest is called for.

We have not examined Dr. Dickerman's paper, because the reference given by Dr. Leonard is so incomplete that previous knowledge is required to identify it. Since we are neither parasitologists nor helminthologists, we will not presume to discuss Dr. Dickerman's usage that is criticized by Dr. Leonard, but will merely comment on Dr. Leonard's conclusions from his stated premises.

In general terms, of course, Dr. Leonard is correct in his position that in Linnaean nomenclature all growth stages of a single species must be called by the same name for taxonomic purposes. Furthermore, the choice of names is governed by priority of publication and not at all by the ontogenetic stage named (Règles Internationales, Art. 27 and 28, not Art. 26 as stated by Leonard). But the reasoning by which Dr. Leonard arrives at a conclusion that is correct in general terms (whether these terms are applicable to Dr. Dickerman's usage or not) is erroneous. In the first place, Dr. Leonard seems to assume that the names *Cercaria* and *Proterometra* were both proposed by Dickerman as new generic names, for he argues that priority between them could be determined by page precedence in Dickerman's work. This is far from being true, for *Cercaria* was first published by Mueller in 1773 and *Proterometra* by Horsfall in 1933 (A. S. Neave. *Nomenclator Zoologicus*, 1940). Furthermore, Dr. Leonard would have realized that the question of priority must have been settled long ago unless he had thought that the names were newly proposed. Priority of publication, not page precedence, would require that *Cercaria* be employed, unless the Règles were suspended by a special act of the International Commission or unless there was some other special circumstance. For example, there is some outside evidence that helminthologists in general, and probably Dr. Dickerman, do not regard *Cercaria* as the name of a genus but of a collective group treated for convenience as if it were a genus (see Art. 8 of the Règles). If this were the case, there might be no nomenclatural conflict, since only one of these names would be available as a generic name under the Règles.

But let us pass this over and assume that both names did originate in Dickerman's paper of 1945 as Dr. Leonard seems to believe, or at least that different growth stages of the same species were called for the first time variously *Cercaria sagittaria* Dickerman (p. 37) and *Proterometra sagittaria* Dickerman (p. 39). Dr. Leonard argues that by virtue of page precedence *Cercaria sagittaria* Dickerman is the "correct name" for the species described. This is fallacious, and it is this argument by Dr. Leonard to which we wish to take vigorous exception. It is particularly important to protest this because of the widespread misapprehension on the subject that probably stems from the fact that page precedence was an important criterion in several other codes of nomenclature long ago superseded by the Règles Internationales.

In the Règles, the code under which zoologists have operated for about 50 years and which Dr. Leonard undoubtedly thinks is the authority for his position, page precedence has no role at all for determining priority

and an extremely minor role for any other purpose. (The version of the code to which Dr. Leonard refers is a very useful unofficial publication of the present official English translation of the definitive French text of the Règles. This translation is known to be defective on some points, and a new official translation is in preparation by the Commission.) It is a criterion for precedence (not priority) between simultaneous names under Recommendation C of Article 28, and for the selection of the type species of a genus under Recommendation t of Article 30. In both it is the last and least significant criterion listed, to be employed only when other things are equal. But recommendations are not articles of the Règles. They indicate preferred, not required, procedure. Priority is determined solely by the date of publication. All parts of a work issued at the same time bear the same date and for purposes of priority are simultaneous. If both names are equally valid, a choice between two synonymous names published simultaneously rests with the first writer to reconsider the point, and thus again priority is a matter of publication date. The revising author may or may not have based his choice on page precedence. It makes not the slightest difference.

The other questions raised here concerning Dr. Leonard's criticisms of Dr. Dickerman's usage must be examined in the light of helminthological taxonomy, but the conclusions of Dr. Leonard appear to us to be far from demonstrated by the evidence he presents.

J. Brookes Knight and R. E. Blackwelder
*Smithsonian Institution, Washington, D. C.*

### Inhibition of Surface Growth

Preserved and embalmed material, including museum specimens, may be attacked superficially by highly resistant organisms. Multiplication and growth of these is of common occurrence both with dry embalmed comparative anatomy specimens and cadavers used in the study of human anatomy. Two chemical inhibitors have been used in our laboratory which are effective in preventing or stopping surface growth. Roccal (a commercial preparation sold by the Winthrop Chemical Company, New York City, to which acknowledgment is due and defined by the maker as a mixture "of high molecular alkyl-dimethyl-benzyl ammonium chlorides") is added to fluid supplied to students for wetting the wrappings of their dissection material. Roccal (commercial grade) is used in concentration of 1: 100 of the usual phenol-formalin dilutions. (The additional cost is approximately $.04 per gallon.)

Similarly, sodium azide in a concentration of 0.1 per cent will usually inhibit all growth. This is more concentrated than that which has been used in agar-plate tests (J. D. Kempf and W. J. Nungester. *Science*, 1944, **100**, 411–412). Sodium azide, 0.1 per cent, is more expensive ($.20 additional per gallon).

Especially resistant surface growth has been stopped by increasing concentration of sodium azide to 0.5 per cent, or of Roccal to 1: 50, and sponging the surface with either solution. No attempt has been made to use either chemical in vats or embalming fluid, since our problem has been one of the dissecting room or laboratory.

There seems to be a personal factor involved in their effective use. This is related to care in sponging off infested areas as well as degree of wetness of cloths used to keep specimens from drying. Students tend to keep their material sopping wet, which encourages growth of molds even on the cloths. All coverings should be twisted or wrung out by hand until the fluid no longer flows freely.

James M. Sanders
*Department of Anatomy,*
*University of Missouri Medical School*

# Book Reviews

*Structural inorganic chemistry.* A. F. Wells. Oxford, Engl.: Clarendon Press, 1945. Pp. viii + 590. (Illustrated.) $7.50.

In the Introduction the author says: "The study of the solid state has greatly increased our knowledge of the different types of chemical bonds." He also states that one not only wishes to know the general preparative methods but also asks ". . . about a compound . . . what is it made of, what holds the constituent parts together, and how are they arranged?"

Much of the material with which the author deals is now being studied in the new subdivision of chemistry called "crystal chemistry." It is amazing that he has been able, during the strain of the past few years, to review and correlate the tremendous mass of information found in this book. An idea of the scope of the work may be obtained from the following list of topics: I. The Structure of the Atom; II. Forces Between Atoms; III. Spatial Arrangement of Atoms; IV. The states of Aggregation; V. The Crystalline State; VI. The Experimental Methods of Structural Chemistry; VII. Hydrogen; VIII. The Halogens; IX, X, and XI. Oxygen and Sulfur; XII. Nitrogen and Phosphorus; XIII. Carbon; XIV. Silicon; XV. Boron; XVI. Stereochemistry of Certain Metals; and XVII. Metals and Alloys.

Since there are so many more metallic than nonmetallic elements, the method of arrangement of the material by the author lends itself to better correlation of information. The various types of bonding involved in the solid state and the hypotheses and theories proposed to explain

these are discussed and illustrated with data taken from the literature. Many times the author points out certain compounds or classes of compounds which have had inadequate study. To the person interested in the solid state this book should prove to be a fruitful source for new problems of study.

The reviewer noticed few errors. One statement with which some may disagree, however, is to the effect that certain metallic hydroxides, upon solution in excess sodium hydroxide, do not form hydroxide complexes but are dispersed in the colloidal state (p. 348).

There are two short reference sections, the first group being to special topics and the second to the literature cited. There is a formula index as well as a subject index. The former is a great aid for the rapid location of the discussions about a particular substance.

The author made no attempt to give the complete data for most of the substances mentioned since most of this material can be found in the Strukturbericht and literature cited. This book should prove to be a useful companion text for use in university courses in advanced inorganic chemistry.

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***A history of the conic sections and quadric surfaces.*** **Julian Lowell Coolidge. Oxford, Engl.: Clarendon Press, 1945. Pp. xi + 214. $6.00.**

The curves known as "conic sections," or "conics," have played a prominent role in the history of mathematics. First studied by the Greeks, they were almost forgotten for 1,400 years. Then interest in them revived, and during the 18th and 19th Centuries they were a focus for the development of the most beautiful chapter in mathematics, the theory of synthetic projective geometry. Toward the end of the last century their popularity declined, since most of their properties had been found and interest was shifting to other topics. Today we are concerned with them mostly from an historical or a pedagogical point of view.

In Prof. Coolidge's book is given a detailed account of the history of the conics from the earliest times to the present. The author's general method is to discuss the contributions of the various writers on these curves, indicating their methods of proof, their important results, and the relationship of their works to the main trend of the subject as a whole. Most of the theorems quoted are proved in detail, usually in the original notation.

The contents of the book can be divided roughly into five parts. First, there is the early Greek period, when the basic properties of conics were established. Then comes the synthetic development, from Desargues and Pascal, through the development of poles and polars and the theory of duality, to the purely projective geometry of Poncelet and Von Staudt. Parallel to this was the analytic treatment. This got off to a slow start, but once the necessary algebraic technique had been introduced, it quickly duplicated the results of the synthetic treatment and then went beyond these into the theory of invariants and linear systems.

The fourth division of the material includes various results which fall outside the main trend outlined above. There are various metric theorems concerning areas, lengths, and curvature, properties of systems of conics in three-space, and mechanical means for describing conics.

The last division is concerned with quadric surfaces. Their history roughly parallels that of the conics, but with a definite time lag. The basic ideas are nearly always evolved first for the conics and then applied to the quadrics. The important exceptions are the theory of the rulings and the differential geometry, neither of which has an analogue in the conics.

The author states that his intention was to give a systematic account of the historical development of the theory of conics and quadrics. This he has done in a clear and entertaining manner. But he has done more. By including actual proofs of the important theorems he has produced a type of textbook that will be of great value to those interested in projective geometry. It is not a textbook that one would recommend to a beginner, but one for a teacher or a student who wants to learn more about the subject than can be readily found in standard texts or references. For example, although a complete account of the theory of linear systems of conics is not presented, enough will be found to indicate the general nature of the subject, and references provide a means of continuing the study. Such a book will clearly be of great value to a teacher of projective geometry who wishes to include some fresh material in his course.

A few typographical and factual errors were noted, but none of them is serious and they detract very little from an otherwise excellent book.

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***The psychoanalytic theory of neurosis.*** **Otto Fenichel. New York: W. W. Norton, 1945. Pp. xii + 703. $7.50.**

Shortly after the publication of this book—his "opus magnum"—the author died, leaving this important contribution to the field of psychoanalysis. He had undertaken the unusually difficult task of writing a textbook on psychoanalytic theory, a field in which good textbooks are conspicuously lacking because this growing discipline only recently has become ripe for such presentation. Almost all the original fundamental contributions were made by Freud, whose writings contain all the struggles of a creative mind to conquer intellectually a new field, the science of human personality. After having developed a special technique of investigating psychological phenomena, Freud and his early followers accumulated an impressive inventory of solid observations, psychological facts, which hitherto were known intuitively only to the greatest novelists and dramatists. To build a theoretical structure upon this evasive but well-established observational material was the life work of Freud. It is only natural that his attempts at formulating generally valid principles and concepts from this factual substratum, compared with other natural sciences, remained crude

and of a preliminary nature. Freud was aware of this and constantly revised his theoretical views concerning the basic impulses (instincts) and anxiety. These formulations, like overlapping geological layers, contain ideas belonging to different phases of his intellectual struggles.

Fenichel did not possess sufficient independence of critical judgment to distill successfully from this heterogeneous compound of theoretical concepts a consistent theoretical system. This is particularly true of the first portion of his book, which was added as a general theoretical introduction to his original publication, *Outline of clinical psychoanalysis*, from which this present book has been rewritten. In spite of the attempt to present clinical psychoanalysis in the framework of a theoretical system, this book, as his first one, is more a reference book than a text. It will be of immense value to advanced students, particularly research workers in the field, because it contains a meticulous and well-nigh complete survey of the significant psychoanalytic writings. However, it will not make it easier for the student to learn the basic concepts of psychoanalysis. With the exception of isolated portions, the author did not succeed in further clarifying or expressing with less verbosity the principles of psychoanalysis. This is not true, however, of the last chapter, devoted to "Therapy and Prophylaxis of Neuroses." Here Fenichel succeeds in freeing himself to a degree from traditional ways and approaches this important topic with much more freshness of thought than the remaining topics.

In the general part, the fundamental dynamic facts and the generalizations built immediately upon them—the concepts of repression, projection, displacement, substitution, reaction formation, rationalization, identification, and particularly the integrative functions of the Ego and the specific forms of its failures—are not given sufficiently thorough treatment. No attempt is made to present them in the framework of generally valid psychodynamic principles in order that they may serve as a solid foundation for the whole theoretical structure. As a result, the book is not a cohesive, compact presentation but a somewhat kaleidoscopic exposition of observations, generalizations of lower and higher grade, and speculative superstructure. There is very little critical reservation, particularly in applying highly theoretical concepts to observational material. This creates an overly didactic impression.

A good textbook on psychoanalysis remains to be written, and the author of this future book will find Fenichel's reference work of immense help as a source of information. Fenichel, in a selfless manner, kept in the background and tried to present his material as much as possible in conformity with previous formulations. The places in which he used his own judgment and reasoning are superior, which further proves that science is in constant organic growth and cannot stand still. The follower's role is not only to build upon the foundations laid down by his scientific predecessors but also to try constantly to clarify what he inherited and to express it with the greatest possible internal consistency.

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# *Scientific Book Register*

ALLEN, EDGAR V., BARKER, NELSON W., HINES, EDGAR A., with associates in the Mayo Clinic and Mayo Foundation. *Peripheral vascular diseases.* Philadelphia-London: W. B. Saunders, 1946. Pp. xii + 871. (Illustrated.) $10.00.

ANDERSON, J. ANSEL. (Ed.) *Enzymes and their role in wheat technology.* (American Association of Cereal Chemists Monogr. Ser., Vol. I.) New York: Interscience Publishers, 1946. Pp. ix + 371. (Illustrated.) $4.50.

AVERILL, LAWRENCE AUGUSTUS, and KEMPF, FLORENCE C. *Psychology applied to nursing.* (3rd ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. xv + 496. (Illustrated.) $2.50.

BOWEN, E. J. *The chemical aspects of light.* (2nd ed.) Oxford, Engl.: At the Clarendon Press, 1946. Pp. 300. (Illustrated.) $5.00.

CANNON, WALTER B., and FIELD, RICHARD M. *International relations in science: a review of their aims and methods in the past and in the future.* Waltham, Mass.: Chronica Botanica, 1946. Pp. 255–298. Gratis. (Also obtainable from Division of Foreign Relations, National Research Council, Washington, D. C.)

DE GANAY, SOLANGE. *Les devises des Dogons.* (Travaux et Mémoires de l'Institut d'Ethnologie, XLI.) Paris: Institut d'Ethnologie, 1941. Pp. viii + 192. (Illustrated.)

DIETERLEN, G. *Les ames des Dogons.* (Travaux et Mémoires de l'Institut d'Ethnologie, XL.) Paris: Institut d'Ethnologie, 1941. Pp. viii + 263. (Illustrated.)

HUDSON, P. S., and RICHENS, R. H. *The new genetics in the Soviet Union.* Cambridge, Engl.: Imperial Bureau of Plant Breeding and Genetics, 1946. Pp. 88.

MCCLUNG, L. S. *General bacteriology laboratory manual.* Philadelphia-London: W. B. Saunders, 1946. Pp. ix + 106. $1.25.

SCHRÖDINGER, ERWIN. *Statistical thermodynamics.* Cambridge, Engl.: At the Univ. Press; New York: Macmillan, 1946. Pp. 88. (Illustrated.) $1.50.

SELLEW, GLADYS, and FURFEY, PAUL HANLY. *Sociology and social problems in nursing service.* (2nd ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. xv + 379. (Illustrated.) $2.75.

SEMAT, HENRY. *Introduction to atomic physics.* (Rev. ed.) New York: Rinehart, 1946. Pp. xi + 412. (Illustrated.) $4.50.

SEWARD, GEORGENE H. *Sex and the social order.* New York: McGraw-Hill, 1946. Pp. xi + 301. (Illustrated.) $3.50.

WILLIAMS, JESSE FEIRING. *Personal hygiene applied.* (8th ed.) Philadelphia-London: W. B. Saunders, 1946. Pp. xii + 564. (Illustrated.) $2.50.